

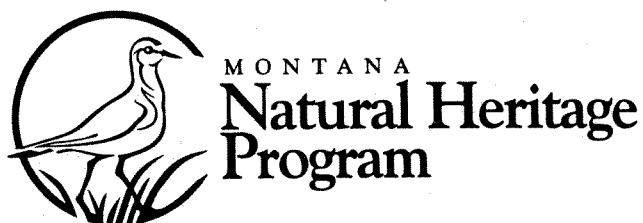
Effect of Gate Installation on Continued Use by Bats of Four Abandoned Mine Workings in Western Montana

A Report to:

Montana Department of Environmental Quality
Mine Waste Cleanup Bureau
2209 Phoenix Avenue
Helena, Montana 59620-0901

Submitted by:
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December, 1999



**EFFECT OF GATE INSTALLATION
ON CONTINUED USE BY BATS
OF FOUR ABANDONED MINE WORKINGS
IN WESTERN MONTANA**

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INTRODUCTION

In 1996 the Mine Waste Cleanup Bureau of the Montana Department of Environmental Quality installed culvert gate systems in the portals of four abandoned mine adits in western Montana. Two gates were installed at the McDonald ("Ravalli") Mine adits in Lake County, and two more were placed in portals at the Gypsum Mine workings of Lewis and Clark Caverns State Park in Jefferson County. Inspection of these mine adits prior to gate installation revealed that each was used at some time during the year by bats, particularly Townsend's Big-eared Bat (*Corynorhinus townsendii*), a U.S. Fish and Wildlife Service species of special concern (Harvey et al. 1999).

Gates were installed to allow for continued use of each mine working by bats while prohibiting accidental livestock entry and unauthorized access by humans. Gates were built with 13 mm rebar attached to an angle iron gate frame, using recommended vertical spacing at least 5.75 inches and horizontal spacing at least 24 inches (Tuttle and Taylor 1994, Dalton and Dalton 1995). The gate itself was attached to a corrugated metal pipe that was inserted into the mine portal, surrounding the pipe with fill to assure that entry into the mine was through the pipe and gate; the gate was secured with a protected padlock. Although the gate design was supposed to be bat-friendly, no follow-up study had been conducted at any of the sites to determine if bats were still using the sites after gates were in place.

The objectives of the work described in this report were two-fold. First, determine the effectiveness of the gate design in its primary function of allowing continued access by bats to the mine workings. Second, gather mine environment data (temperature, relative humidity) continuously over a several month period to aid in characterization of the mine environments where bats occurred.

STUDY SITES AND METHODS

The McDonald ("Ravalli") Mine is just west of the small community of Ravalli, in Lake County, T18NR20WS31NWN at about 853 m (2800 ft) elevation near the Jocko River and at the southern boundary of the National Bison Range. The mine includes three open adits that produced crude copper ore, the lower two of which are now gated. The mine has not been worked since 1917 (Rossillon 1995).

The Gypsum Mine lies within the boundary of Lewis and Clark Caverns State Park, in Jefferson County, about 275-305 m (900-1000 ft) elevation below the mouth of the cave, and overlooking the Jefferson River. The mine is part of a 118-acre claim patented in 1915 that includes a number of prospects, a large open pit, and a couple of adits. The two gated adits are in T1NR2W in S21NWNW (adit #1) and S20NENE (adit #2), at about 1432 m (4700 ft) and 1390 m (4560 ft) elevation, respectively.

During mine surveys, all bats encountered were recorded and identified to species, if possible, taking care not to disturb the bats. Location of bats within the mine was noted, and a series of temperature and relative humidity measurements were made with a Bacharach sling psychrometer. Mines were explored to the fullest extent possible, which depended in part on underground configuration and relative hazard. At least one electronic data logger (HOBO; Onset Computer Corporation, Bourne, MA) was installed in each working, usually within the area occupied by bats. Data loggers, set to record temperature and relative humidity every 6

hours, were attached to extendable aluminum poles (Mr. Longarm, Inc., Greenwood, MO) using duct tape, and positioned to within 40 cm of the ceiling (ca. 1.4 to 2.0 m above ground). Location of data loggers relative to portals was documented; data loggers were left in mines for 6-7 months before retrieval. Data loggers in the McDonald Mine adits were installed on 7 December 1998 and retrieved on 13 July 1999. At the Gypsum Mine, data loggers were installed on 6 January 1999 and retrieved 13 July 1999. Summary Figures portraying data logger results are presented at the end of this report.

RESULTS

McDonald Mine Sites. On 7 December (13:10-16:30 MST), the two (east and west) gated adits were entered and data loggers installed. In the East Adit, 8 hibernating Townsend's Big-eared Bats (*Corynorhinus townsendii*) were found on the walls of the entrance hallway in the first 39.7 m (130 ft) beyond the gate. A data logger ("shallow") was placed at this point 39.7 m from the portal, where the main passage angles sharply to the west (left). A second data logger ("deep") was placed 106.7 m (350 ft) from the portal in this west-trending passage, shortly before the workings open into a large room ascending to at least one additional level. No bats were found in this section of the mine on the December survey, and the second level beyond the large room were not checked. On the 13 July survey, a single unidentified *Myotis* flew from the entrance when it was entered (08:17) but no additional bats were present in the first part of the mine. One Townsend's Big-eared Bat was seen flying in the upper parts of the large room. It is possible other bats were present in this portion of the mine.

In the West Adit no bats were found during the 7 December survey. This working was surveyed entirely (about 50 m; 164 ft), and a data logger was left where the main haulway angles sharply to the east, 12.7 m (41.7 ft) from the entrance. On the 13 July survey, a single Townsend's Big-eared Bat flew from the entrance area and a nursery colony of 20-25 individuals was found clustered tightly on the wall of the east-trending passage near its juncture with the entrance passage, about 2.0 m (6.5 ft) beyond the data logger.

The upper ungated adit was surveyed on 7 December; no bats were found. The working is relatively shallow, extending 17.1 m (56 ft) beyond the portal.

Climate data from the lower gated adits (Table 1, Figures 1-6) show all workings were relatively cool during the recording period (8 December 1998 to 13 July 1999). Temperature

TABLE 1. Maximum and minimum electronic data logger values for temperature (°C) and relative humidity (RH; %) at the McDonald Mine sites (8 December 1998 to 13 July 1999) and Gypsum Mine sites (7 January 1999 to 13 July 1999).

Mine Working	Elev. (m)	Max. Temp.	Min. Temp.	Max. RH	Min. RH
McDonald East (shallow)	853	11.1	-0.2	100	28.1
McDonald East (deep)	853	11.9	7.9	100	89.5
McDonald West	853	15.0	9.1	97.8	59.0
Gypsum #1 (upper)	1432	--	--	--	--
Gypsum #2 (lower)	1390	7.1	0.3	98.9	71.1

varied by 12°C (20°F) 39.7 m from the portal in the East Adit during this period. The range was 6°C (10.4°F) 12.7 m from the portal in the West Adit, and only 3.5°C (6.1°F) deep in the East

Adit 106.7 m from the portal. Maximum temperatures were recorded during the first two weeks of July in each adit; minimum temperatures were recorded on 21-22 December 1998 (see Figures 1, 3, 5). The pattern of variation in relative humidity among adits was identical to the pattern for temperature. Relative humidity varied by 81.9% at the shallow location in the East Adit (Figure 2), but only by 10.5% at the deep location (Figure 4, Table 1). In the West Adit, relative humidity varied by 38.8% during the sample period (Figure 6). Maximum values occurred on a range of dates in each adit, from 29 January until July deep in the West Adit and between 5 May and July shallow in the same adit, to a shorter period (18 June to 6 July) in the West adit. Minimum relative humidity was recorded on 21 December in the East Adit, but on 13 July in the West Adit.

Gypsum Mine Sites. The two gated Gypsum Mine adits (#1: "upper" and #2: "lower") were surveyed completely on 6 January 1999, when a single data logger was installed in each. The upper Adit #1 extends straight back for 22.4 m (73.5 ft) from the portal, the lower Adit #2 extends straight back for 44.0 m (144.4 ft). In Adit #1, one Townsend's Big-eared Bat was hibernating 1 m (3.3 ft) above the floor 5.8 m (19.0 ft) from the drift face. In Adit #2, one unidentified *Myotis* (probably the Little Brown Bat *M. lucifugus*) was found hibernating wedged in a crack about 5.0 m (16.5 ft) from the portal; four Townsend's Big-eared Bats were hibernating between 3.4 and 8.0 m (11.2 and 26.2 ft) from the portal. Three additional Townsend's Big-eared Bats were hibernating about 25.5 m (83.7 ft) from the portal. No bats were observed in either adit when data loggers were retrieved on 13 July 1999.

In Adit #1 a data logger was installed where the lone bat was hibernating 5.8 m from the drift face. Unfortunately, this data logger failed to record any data during the recording period (7 January to 13 July 1999). However, at the time the data logger was installed, temperature in this adit ranged from 3.9-6.4°C (39-43.5°F), the warmest value about 3 m (9.8 ft) from the drift face; relative humidity was 53% 12.6 m (41.3 ft) from the portal to the drift face. In Adit #2 a data logger was installed 8 m (26.2 ft) from the portal (36 m from the drift face), at the far end of the primary zone of bat occupancy. At this location mine temperature varied by 6.8°C (12.2°F) in 6 months; relative humidity varied by 27.8% (Table 1). Maximum temperature and relative humidity (Table 1; Figure 7 and 8, respectively) were recorded in the first part of July, just prior to data logger retrieval; minimum values for each variable were recorded on 24 January.

DISCUSSION

Workings at both mine sites were gated because they were known to harbor bats in winter. Townsend's Big-eared Bat (*Corynorhinus townsendii*) has been known to occupy the McDonald Mine workings since at least 1965 (specimens UMZ9942 through UMZ9945, collected 5-6 December; P. L. Wright Vertebrate Museum, University of Montana). More recently the three adits of this mine were surveyed on 6 November 1996. Five hibernating Townsend's Big-eared bats were present in the East Adit (20-61 m from the portal) and another was actively flying; no bats were present in the West Adit. One fresh dead big-eared bat was found in the upper adit as was one active individual, probably the same active bat in the East Adit. Use of the Gypsum Mine adits is less well-documented, but bat activity in and around Lewis and Clark Caverns has been reported for many decades (Lee Flath, pers. comm.).

The surveys reported here indicate continued use of all gated mine workings by bats, certainly an encouraging finding that indicates the gate design in use is, indeed, bat friendly.

Furthermore, the number of bats present (8) at the McDonald Mine adits on 7 December 1998 was nearly identical to the number (7) found in the same portion of workings surveyed on 6 November 1996, just prior to gate installation. This further supports the idea that the gating had little impact on the attractiveness of these mine workings to bats.

The West Adit of the McDonald Mine appears to be used mostly as a maternity site, whereas the East Adit is used as a hibernaculum. The West Adit was warmest with the least humidity, both of which promote more rapid development of young (Humphrey and Kunz 1976). The McDonald East Adit and the two Gypsum Mine adits provide conditions suitable for use as hibernacula by Townsend's Big-eared Bat: temperatures $< 10^{\circ}\text{C}$ but above freezing with high relative humidity (Table 1, Figures 1-8). High relative humidity reduces water loss and desiccation while bats are inactive, low temperature reduces metabolic costs and use of fat stores. The temperature values are similar to those reported for big-eared bat hibernacula in northern California (Pierson et al. 1991), Idaho (Genter 1986), Kansas (Twente 1955), and Oklahoma (Humphrey and Kunz 1976), but not as warm as in other parts of its range (summary in Webb et al. 1996).

RECOMMENDATIONS

- 1) The gate design at the McDonald and Gypsum mines is bat friendly and works. Continue using this design where appropriate at other adits as additional abandoned mines are reclaimed.
- 2) Other gate designs have been installed by the state on abandoned mine workings elsewhere in Montana that are not effective in preventing unauthorized human entry. Some of these designs, using brick walls that may alter airflow, could also alter mine environments and affect their suitability as hibernacula or maternity roosts (Richter et al. 1993). Consider replacing these with the current design, especially at sites where use by bats has been documented.
- 3) Continue monitoring bat use at the McDonald and Gypsum mines. Both sites are ideal for long-term monitoring of a bat species of special concern, and provide both hibernacula and maternity roosts. Monitoring could include multiple visits (every other month) by qualified bat biologists to document timing of occupancy and location in each working throughout the year; special care must be taken to minimize disturbance of bats if monitoring is done this frequently. However, these data will provide a better understanding of roost requirements that may help determine the suitability or lack of suitability of other abandoned mines, and aid in decisions to close or gate other sites.

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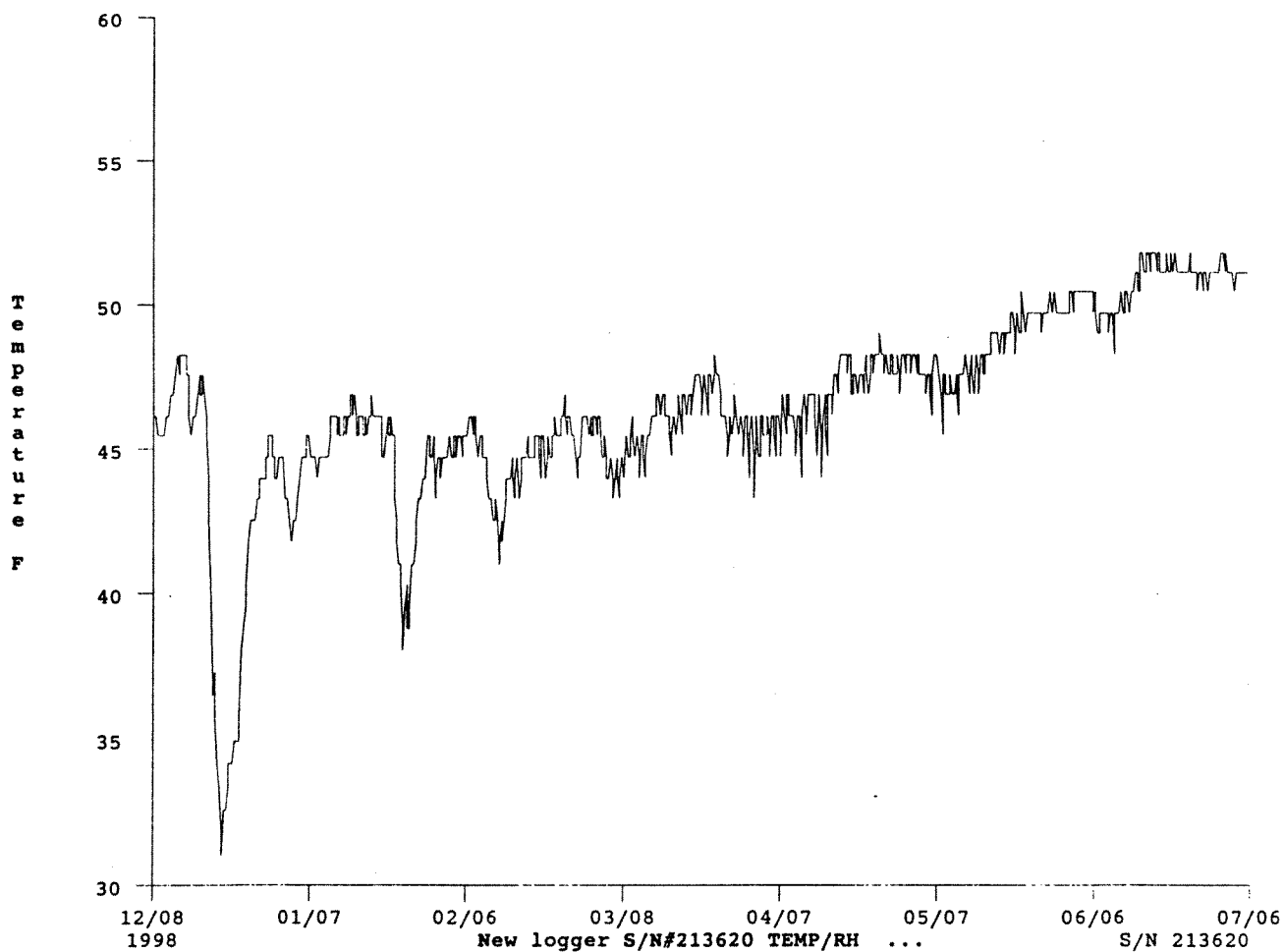


Figure 1. Mine temperature of the McDonald Mine East Adit (shallow location), Lake County, Montana, from December 1998-July 1999. Electronic data recorder was 39.7 m from the mine portal.

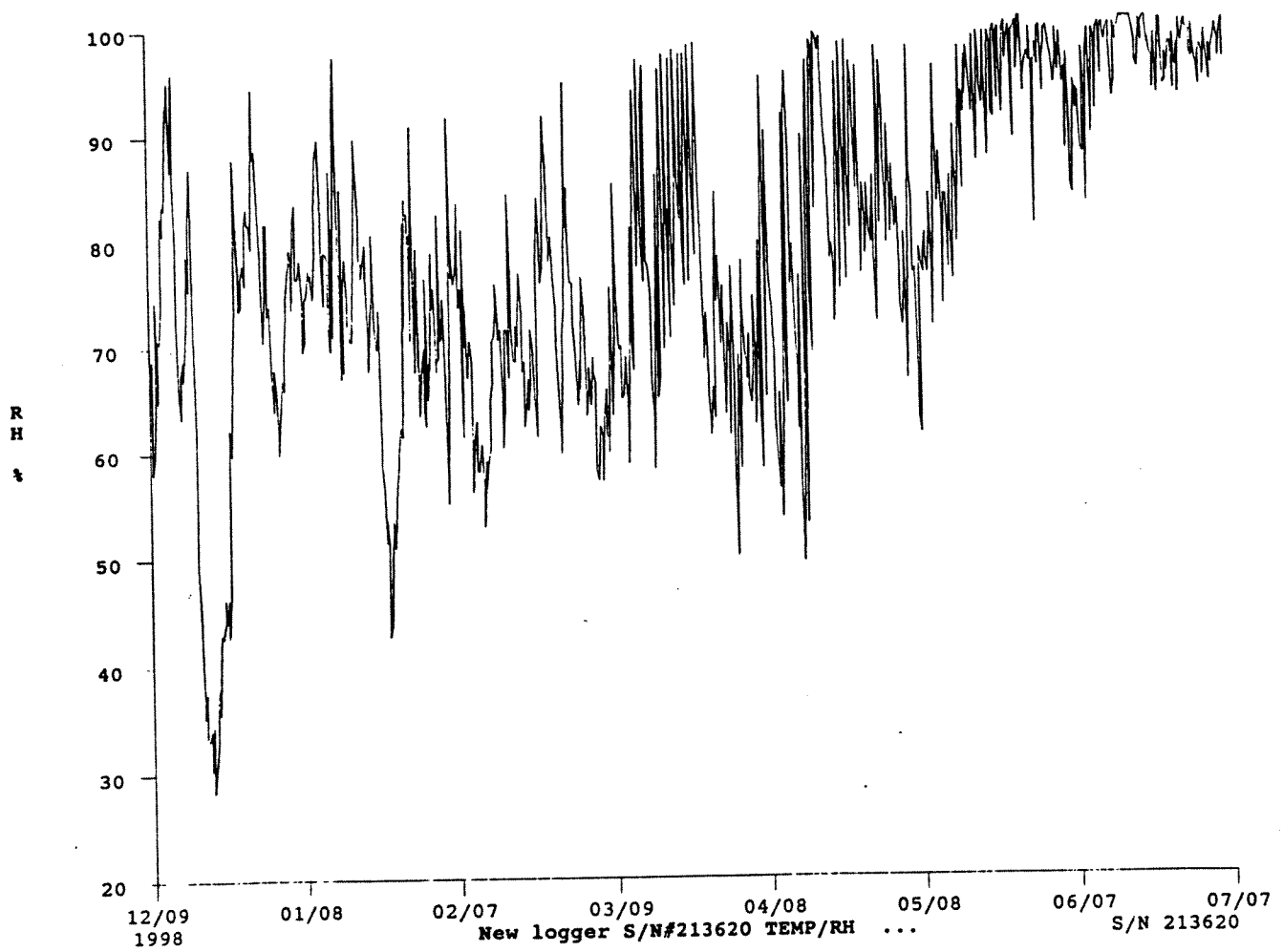


Figure 2. Relative humidity of the McDonald Mine East Adit (shallow location), Lake County, Montana, from December 1998-July 1999. Electronic data recorder was 39.7 m from the mine portal.

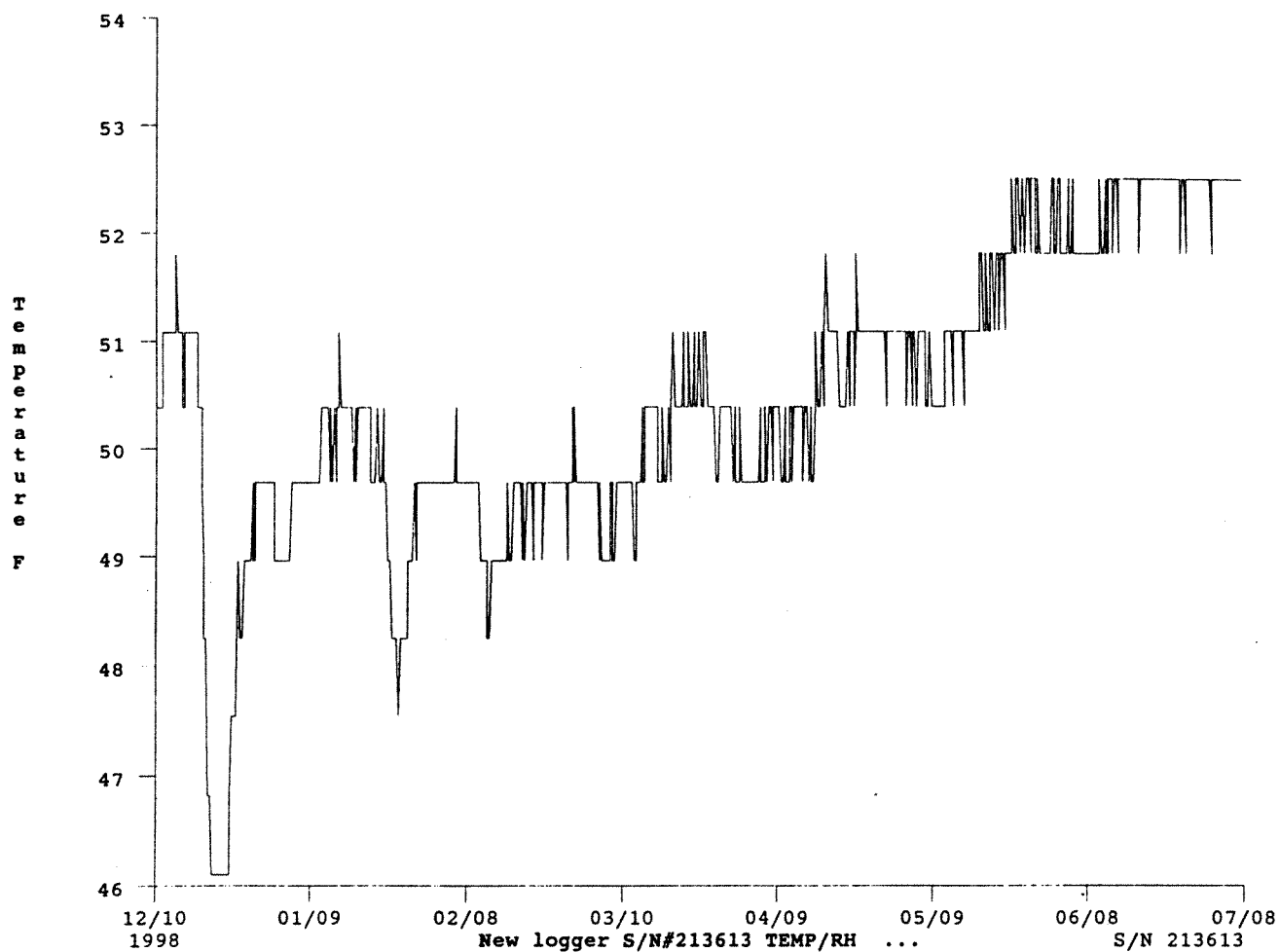


Figure 3. Mine temperature of the McDonald Mine East Adit (deep location), Lake County, Montana, from December 1998-July 1999. Electronic data recorder was 106.7 m from the mine portal.

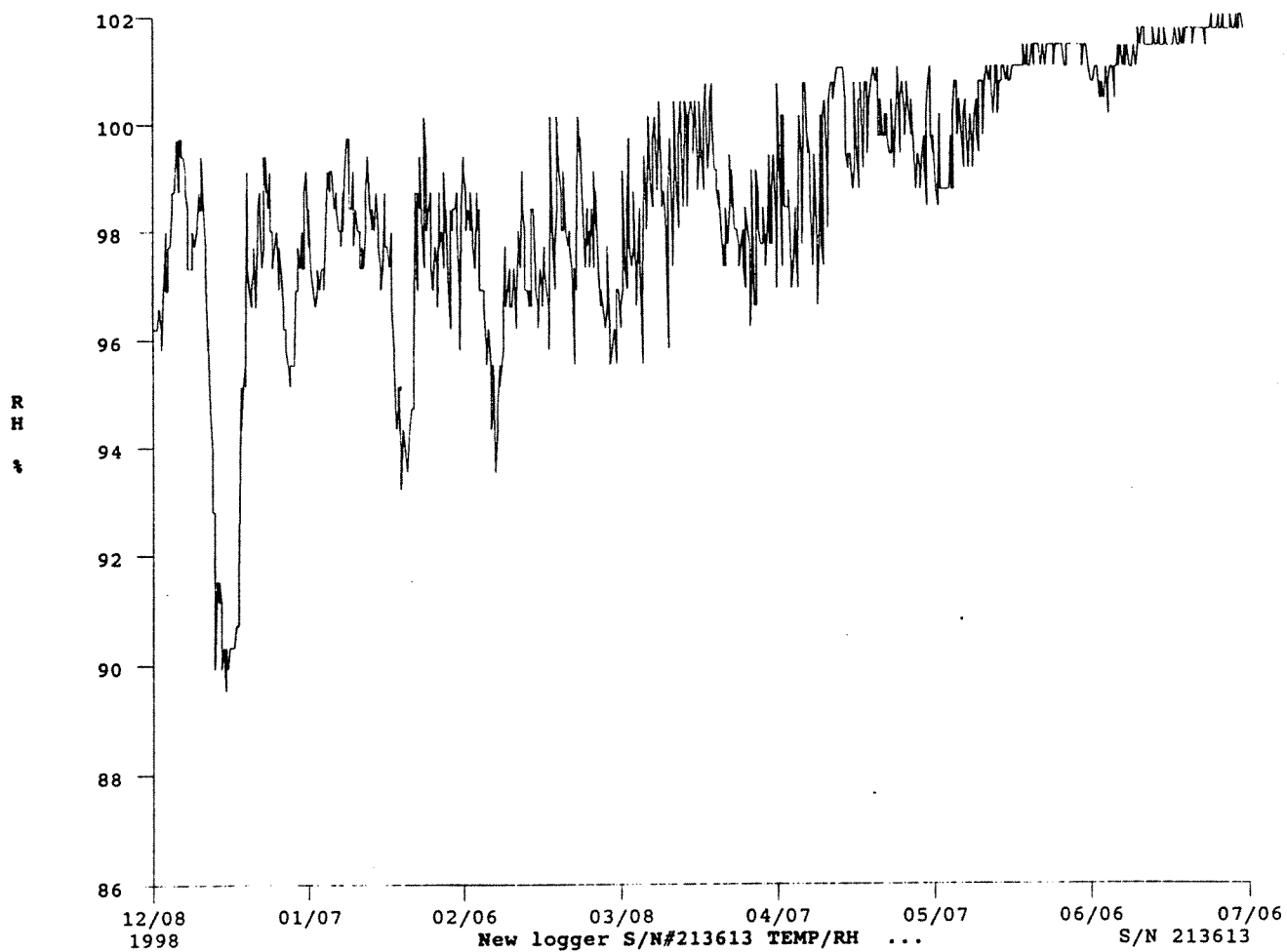


Figure 4. Relative humidity of the McDonald Mine East Adit (deep location), Lake County, Montana, from December 1998-July 1999. Electronic data recorder was 106.7 m from the mine portal.

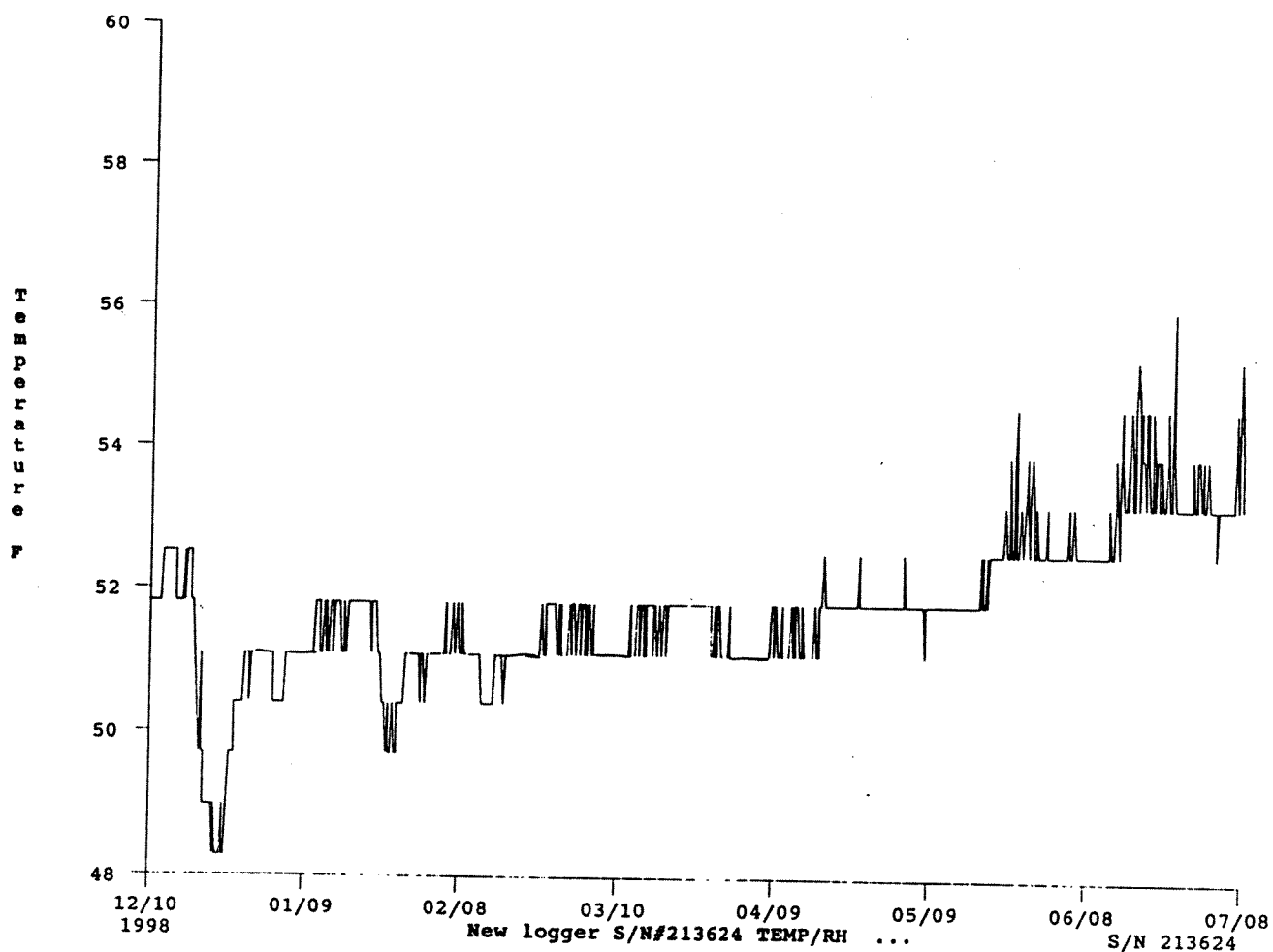


Figure 5. Mine temperature of the McDonald Mine West Adit, Lake County, Montana, from December 1998-July 1999. Electronic data recorder was 12.7 m from the mine portal.

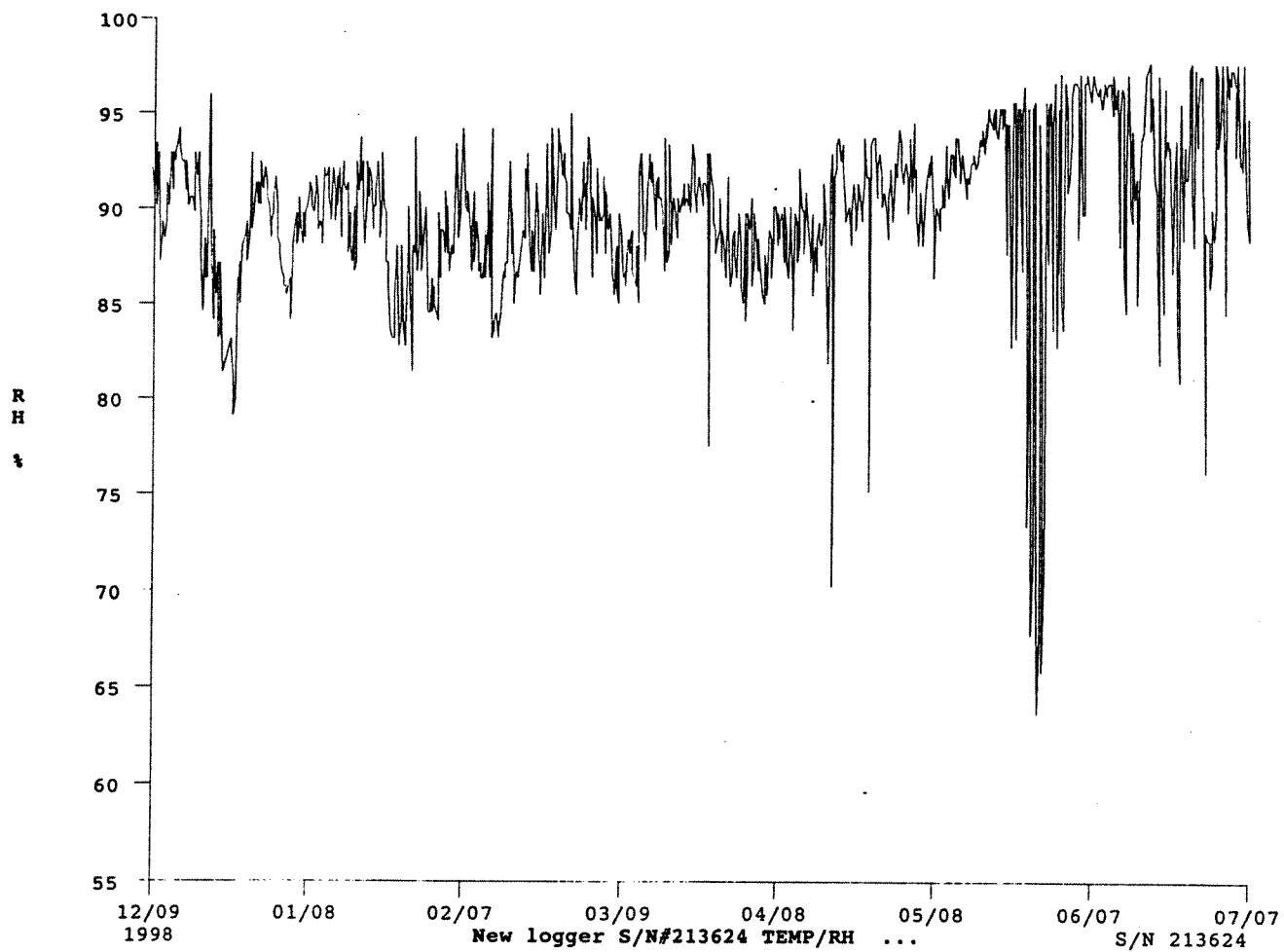


Figure 6. Relative humidity of the McDonald Mine West Adit, Lake County, Montana, from December 1998-July 1999. Electronic data recorder was 12.7 m from the mine portal.

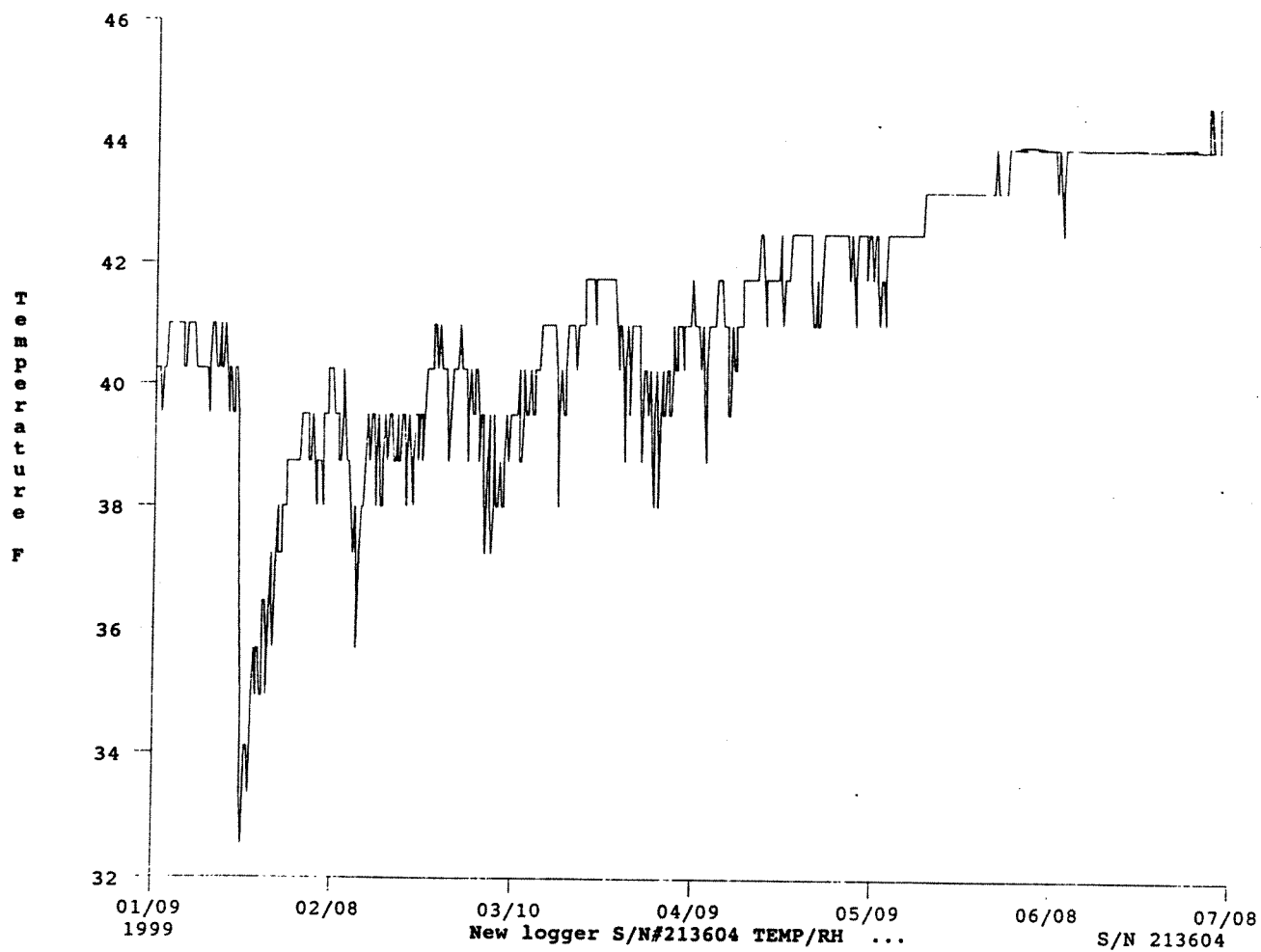


Figure 7. Mine temperature of the Gypsum Mine Adit #2, Jefferson County, Montana, from January-July 1999. Electronic data recorder was 8.0 m from the mine portal.

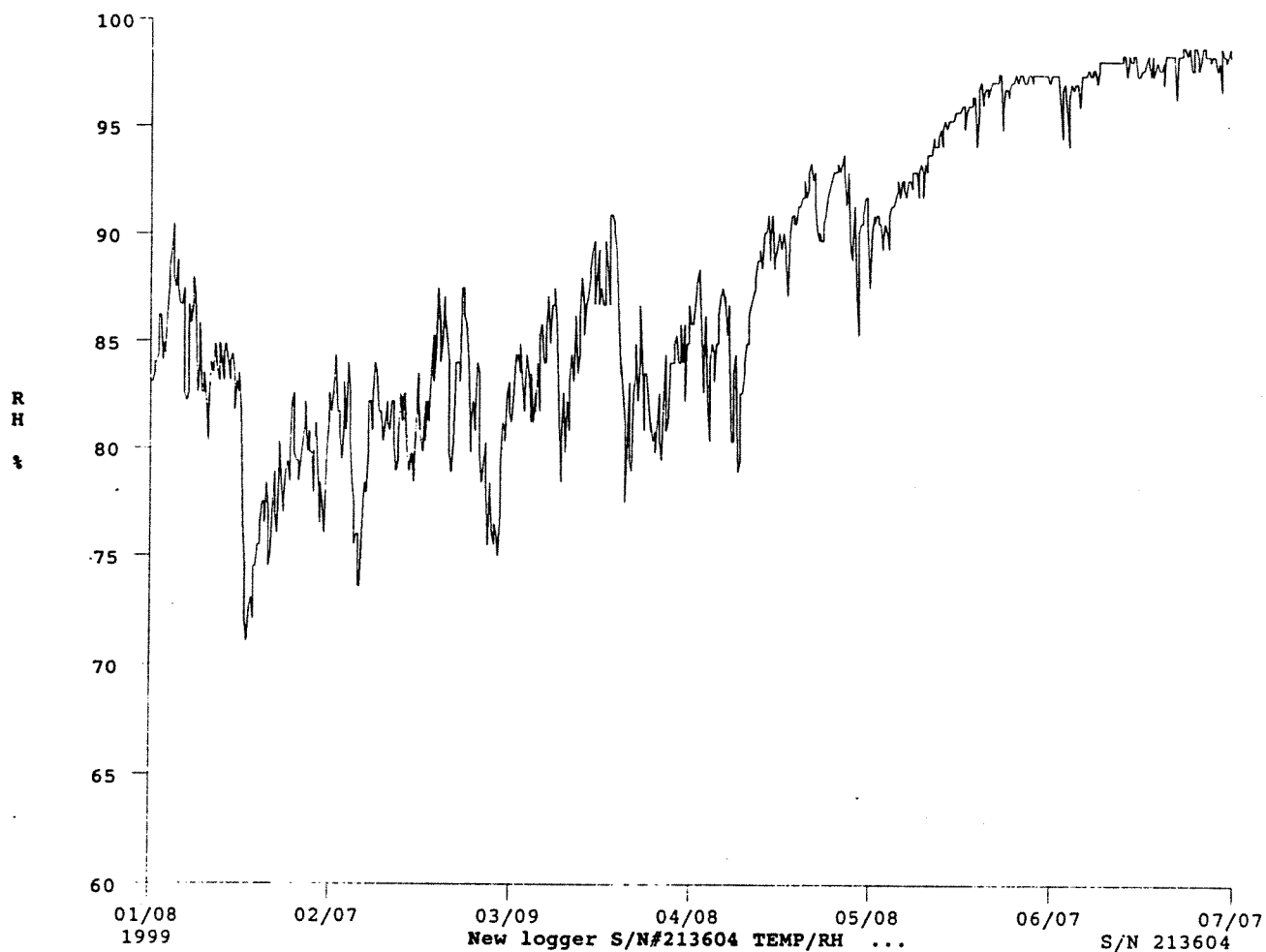


Figure 8. Relative humidity of the Gypsum Mine Adit #2, Jefferson County, Montana, from January-July 1999. Electronic data recorder was 8.0 m from the mine portal.